SuChin catches some rays to find out about solar power.
Segment Length: 8:00

Teacher's Guides Index

Olympic Solar Energy

Show Number 1409

How is the sun used for power?

How does the sun's heat get to the earth through millions of miles of cold space?

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Getting Started

Build a small "greenhouse" out of a plastic, cardboard, or wood box that has a clear cover on the top (glass or clear plastic). Put the tip of a thermometer in a container of black dirt inside the greenhouse, then place the house in the sun or under a floodlight. Check the temperature every 15 minutes to see how much hotter it is inside the greenhouse. Open the top or sides of the box and see what effect that has. Why does heat build up inside of a greenhouse? Can you maintain a constant temperature below the maximum temperature by opening and closing holes, or vents, in your greenhouse?

Overview

Olympic officials stand with a magnifying lens in the ancient temple of Zeus in Olympia, Greece, the site of the first Olympic Games 2,772 years ago. They focus rays of the sun on dry grass. The grass catches fire, and from that "Mother Flame" the Olympic torch is lit, just as it was by the original Olympians.

As the lighting of the Olympic flame shows, the solar energy that strikes the earth is tremendous, despite traveling 93 million miles across space to get here. The total annual energy consumption in the United States is only about two-hundredths of a percent of the solar energy falling on this country each year.

People harness solar energy in many different ways, but the most common methods use solar collectors to heat water and photovoltaic cells to convert sunlight directly into electricity.

Photovoltaic cells, thin wafers usually made of silicon crystals, were first used in 1958 to power satellites in space. Now the cells are used for everything from running lighting systems to powering water pumps.

When photons (the tiny, individual packets of light energy that come from the sun) strike a cell, some are absorbed and transfer their energy to an electron in an atom. The electron, gaining energy from the photon, breaks free of its atom. The cells are made so that one layer of each cell is more highly charged than the other layer. The negative charges move toward the positive ones. The moving charges are an electric current, or electricity. This type of current production is called the photovoltaic effect.

At the 1996 Olympics in Atlanta, 2,856 photovoltaic cells covering 40,000 square feet provided 340 kilowatts of electricity to power the lights in the swimming complex. The water in the swimming pool—one million gallons of it—was heated by a solar thermal heating system. Such systems work by aiming large, black metal solar collectors at the sun. Black and other dark colors absorb more sunlight than light colors. Solar energy makes the collectors very hot, much like the surface of a blacktop road on a bright, sunny day. Water pumped through the collectors is heated naturally and then can be pumped back into the pool. Temperature sensors automatically turn on pumps to use the solar-heated water when the pool becomes too cool.

Solar thermal heaters for swimming pools typically reduce water heating costs by about 50 percent. Many big pools with solar heat also use natural gas heating as a backup for cloudy days when the sun isn't shining.

Connections

1. What are the advantages of producing energy directly from the sun instead of burning coal or natural gas?

2. Photovoltaic cells, solar thermal heaters, and other solar systems have been around for a couple of decades. Why weren't they more widely used?

Resources

Brooke, B. (1992) Solar energy. New York: Chelsea House.

Hufbauer, K. (1991) Exploring the sun: Solar science since Galileo. Baltimore: Johns Hopkins University Press.

Spence, M. (1993) Solar power. New York: Gloucester Press.

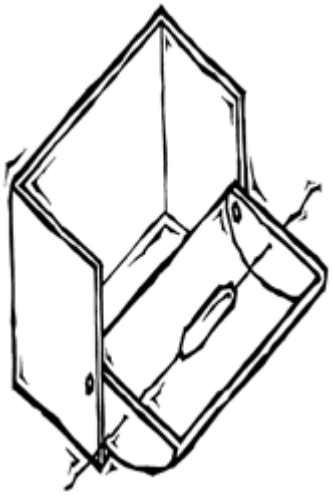
General solar information:
http://www.eren.doe.gov/RE/solar.html

Olympic swimming pool solar site:
http://www.heliocol.com/olym.html

The Center for Renewable Energy and Sustainable Technology: The Sun's Joules.
CD-ROM multimedia encyclopedia about solar energy.
Ordering information: (800) 842-5505.

U.S. Department of Energy: Energy Efficiency and Renewable Energy Clearinghouse
P.O. Box 3048
Merrifield, VA 22116
(800) DOE-EREC
(Assorted booklets on renewable energy)

Student Activity:
Olympic Solar Energy



Solar Cookout

Harness the energy from the sun to power a parabolic oven.

Main Activity

Solar thermal collectors work because they not only gather solar energy, but concentrate it in a small space. In this activity, you'll build a solar oven that, by concentrating sunlight, will gather so much heat you can cook a hot dog.

Materials

- aluminum foil
- poster board
- unpainted coat hanger
- a cardboard box, about 10 1/2" on one side
- a medium-sized piece of cardboard
- glue
- scissors
- marker
- tape
- two nuts and bolts
- hot dogs

1. Cut two sections out of the piece of cardboard to form the ends of a parabolic cooking trough. Cut each piece so it has a straight edge that is 10" long. At the middle of this edge (5" from each end), measure a point 4 1/2" back onto the cardboard and make a mark. Draw an arc from one corner of your straight edge, through the point, then down to the other corner. Cut along the arc and you should end up with two pieces of cardboard that look roughly like half circles.

2. Cut a piece of poster board so that it is 11 1/2" by 14". Cut a piece of aluminum foil the same size and glue it, shiny side up, to the poster board.

3. Curve the poster board around the two end pieces, with the aluminum foil facing in, and tape it in place.

4. Cut the top and front side off of your cardboard box and slide the back of your trough a couple of inches into the box. Secure the trough to the box by putting a bolt through each side of the trough and the sides of the box. Make sure the bolts are toward the rear of the trough. Fasten the two bolts with the nuts. The trough should be able to tilt up and down.

5. Straighten out the coat hanger and push it through the trough, from one side to the other, so it sits like a spit for cooking. It should sit about two inches back from the open front of the trough.

6. Put a hot dog lengthwise on the coat hanger and point the trough at the sun. How long does it take the hot dog to get warm? Does it cook faster if you move the coat hanger a little deeper into the trough?

Questions

1. What other machines could you build that would use the sun's energy?
2. What can the sun's energy do around your house? Draw plans that would maximize sunlight energy in your house without using photovoltaic cells.

Use a magnifying glass to focus sunlight on a piece of black construction paper. How long does it take before the paper starts to smoke? Repeat the procedure using white construction paper. Does it take more or less time to start smoking? Why?

Purchase a photovoltaic cell and an electric analog clock. Wire the cells to the clock, set the clock at 12, and then put the whole apparatus outside. At the end of the day you will know exactly how much time the sun was shining and how much time it spent behind the clouds.

Fill some ice cube trays with water to the same depth. Add different colors and concentrations of food coloring to different cubes. Stir well. When the ice cubes freeze, you should have a collection of cubes in a variety of colors. Set them out in the sun and see which ones melt the fastest. Why don't they all melt at the same rate?

3M Innovation

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